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CERL'S FACILITIES FOR DETERMINING BALLISTIC PROPERTIES OF AMMUNITION

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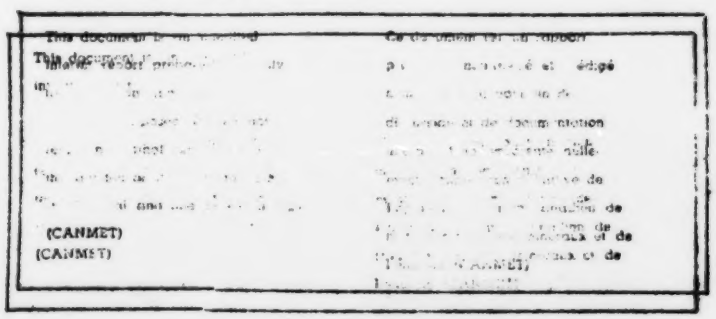

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CERL'S FACILITIES FOR DETERMINING BALLISTIC PROPERTIES OF AMMUNITIONS

by

T.R. Craig*

ABSTRACT

This report outlines the procedure followed in determining the projectile velocity and the chamber pressure of sporting ammunition. Light-sensing diodes and conformal piezoelectric pressure transducers are used, respectively, for detecting the velocity and pressure. Results on standard rounds of ammunition are in close agreement with values published by manufacturers.

Keywords: Bullet velocity, Chamber Pressure, ammunition.

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INSTALLATION D'ESSAIS BALLISTIQUES SERVANT À MESURER LES CARACTÉRISTIQUES DE MUNITIONS

par

T.R. Craig*

RÉSUMÉ

Ce rapport contient une brève description de la méthode utilisée pour déterminer la vitesse du projectile et la pression de la chambre lors d'essais avec les munitions de fusils de chasse. Des diodes détecteurs de lumière et des transducteurs de pression piézo-électriques sont utilisés respectivement pour détecter la vitesse et la pression. Les résultats d'essais avec des cartouches ordinaires sont en accord avec les valeurs publiées par les fabricants.

Mot-clés: vitesse du projectile, pression de la chambre, munitions.

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INTRODUCTION

The Canadian Explosives Research Laboratory is responsible for testing for the purpose of authorization sporting ammunition produced and/or sold in Canada. Ammunition samples are subjected to different tests including the determination of velocity and pressure.

THE TESTING FACILITY

The testing facility is located in Building 14. It is basically comprised of two parts. These are the range and the instrumentation room.

The range is 25 m long, 2 m wide and 2.3 m high. In it are located the projectile velocity detecting devices and a sand trap that safely catches the projectiles. Figure 1 shows the two velocity detectors and the protective projectile deflectors mounted on an aluminum channel.

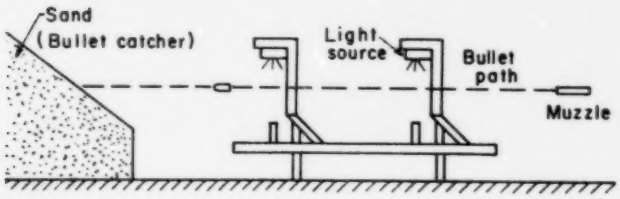

Fig. 1 - The projectile velocity detectors

In the instrumentation room are located the universal receiver (Fig. 2), the projectile velocity display equipment, and the pressure detector and recording apparatus (Fig. 3).

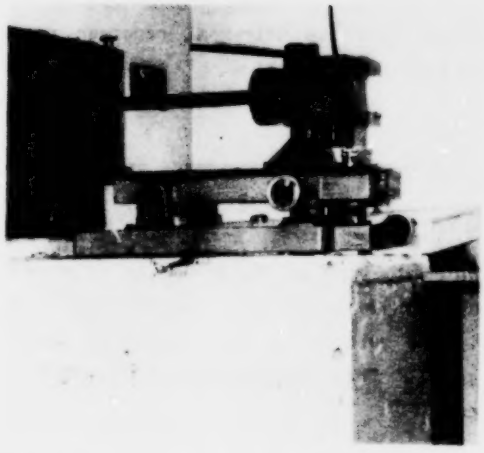

Fig. 2 - The universal receiver

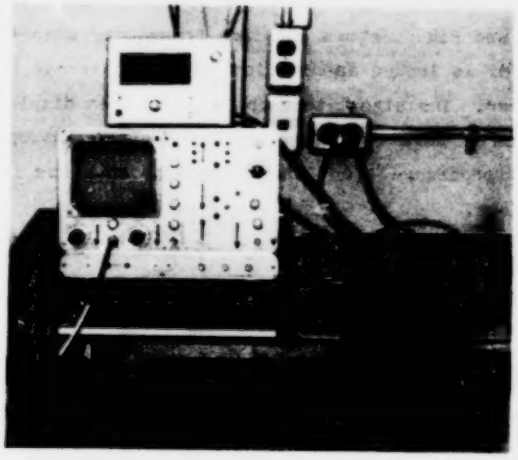

Fig. 3 - Projectile velocity and chamber pressure recording instruments

SAFETY REQUIREMENTS (BEFORE COMMENCING TEST)

1. Refer to general requirements for use of the building 14 test site.

2. Before proceeding, inspect ammunition for any physical deformities that could pose a hazard during the testing process.

3. Check the range for explosive items being stored for the purpose of temperature conditioning, and remove before commencing test.

4. Whenever entering the range, make certain that the receiver is not loaded and that the breech block is left in the open position.

5. Check that barrel being used is clear and clean.

6. Always fire the universal receiver remotely and wear ear protection.

DETERMINING THE PROJECTILE VELOCITY AND THE CHAMBER PRESSURE

The velocity is measured by firing the projectile over two detectors set a fixed distance apart. The velocity is then digitally displayed on a panel. This instrumentation is detailed in reference (1).

The chamber pressure is detected with a conformal piezoelectric pressure transducer (3), located in the chamber area of the barrel. Figure 4 shows the transducer installed on a barrel and Fig. 5 shows the same transducer when the barrel is locked in position in the universal receiver. The signal thus obtained is then displayed on a peak reading meter or an oscilloscope. The procedure for these measurements is as follows.

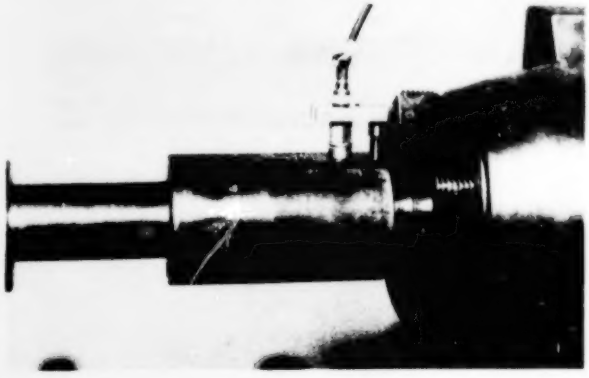

Fig. 4 - Pressure transducer installed on a barrel

1. Turn on all instrumentation and allow it to stabilize for at least thirty minutes.

2. Connect the start and stop velocity detectors with the cables supplied to the corresponding connectors on the velocity recording instrument. Be sure to match the distance between the detectors to that set on the velocity recording instrument. This will ensure that the displayed velocity is in the appropriate units, meters per second.

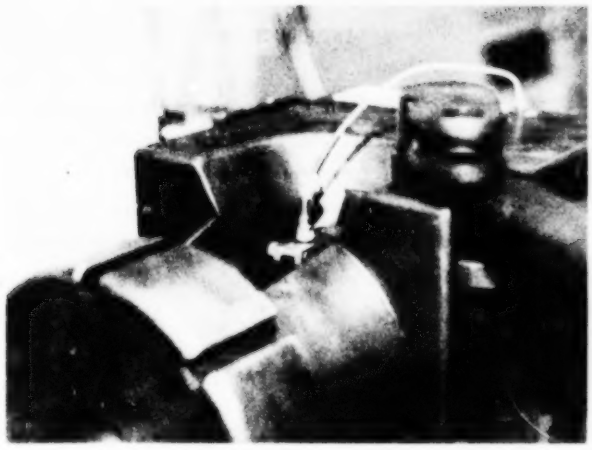

Fig. 5 - Pressure transducer as seen when the barrel is installed in the universal receiver

3. Switch on the detector lights.

4. Turn on the range exhaust fan with the switch located on the wall outside the instrumentation room.

5. Install the barrel on the universal receiver for the caliber being tested.

6. Inspect the transducer mounting cavity in the pressure barrel to assure that the seal seat is free of dirt and any other firing matter.

7. Install the transducer so that its surface is flush with the chamber's inside surface. The transducer must have the proper alignment and depth. Depth adjustment is accomplished with the use of various different thickness spacers. The alignment is achieved by using the transducer's alignment clamp.

8. With the transducer properly aligned, torque the transducer nut to specification.

9. Inspect the chamber and be sure that the transducer sensing surface is flush with the surface of the test chamber.

10. Connect the transducer to the appropriate ballistic amplifier with the supplied low noise cable. The transducer sensitivity setting is dialed into the amplifier. The output of the amplifier is than connected to a peak reading meter or an oscilloscope to record the peak pressure value or a complete pressure profile. The pressure is reported in Megapascals (MPa).

11. To load a round, rotate the cartridge through 360° to collect the propellant in one area. Maintain the cartridge so that the primer is below the bullet as it is being loaded. This will ensure intimate contact of the propellant with the primer. Figure 6 shows a shotshell being properly chambered.

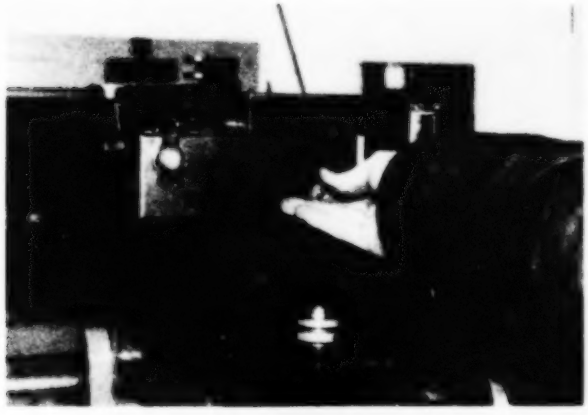

Fig.6 - Shotshell being properly chambered

12. Reset all instrumentation and ensure that the digital peak reading meter displays zero.

13. Fire the receiver using the remote firing system.

14. Record the acquired data.

15. Using the extractor, remove the spent cartridge. Observe the cartridge for any signs of deformation, especially in the primer area.

16. In the case of a dud or hangfire caused by such faults as small or decomposed primer composition, damp propellent, or light blow of the firing pin, leave the round in the chamber and fire the gun again.

17. If the round does not fire, wait a minimum of 10 minutes before extracting the cartridge. During this time, look and listen for any indication of a reaction. When fully satisfied that there is no reaction or that the reaction is over, stand to one side of the gun so as to be out of the direct line of the cartridge base and carefully slide out the breech block. Note and record any obvious conditions that may have caused the malfunction. Destroy the cartridge when testing is completed.

18. Inspect chamber and barrel and clean if necessary before continuing to the next round.

DATA REDUCTION

The reported velocity and pressure is simply an average of all those measured. A comparison is then made with the values published by SAAMI. Presently, there are no restrictions on the measured velocity. However, the pressures must comply with the critical values listed in the SAAMI manuals. These values are:

1. the recommended loading limit,
2. the maximum product average, and
3. the maximum permissible individual pressure.

The following example illustrates how these limits for a .38 cal Special 158 grain semi-wadcutter cartridge are used. The data as listed in the SAAMI manuals are listed below in Megapascals.

Recommended loading limit	Maximum product average	Maximum permissible individual pressure
117	124	143

The following statistical results are possible.

1. The sample mean is less than 124 and the individual maximum is less than 143.

2. The sample mean is less than 124 and there is at least one outcome greater than 143.

3. The sample mean is greater than 124.

Considering the above possibilities, the sample would pass this test if condition 1 was met. However, if either conditions 2 or 3 existed, the sample would fail. Simply stated, the mean and the individual maximum of the sample must not exceed the corresponding values published in SAAMI.

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